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codes. In spite of the fact that the Allies controlled all overseas mails and cables, the German Government was apparently able to communicate at will, for a time at least, with its embassies and agents everywhere.

It would seem as if no article on this subject should omit a reference to the work of John Wallis, who has been called by D. E. Smith[1] "one of the world's greatest decipherers of cryptic writing," or to Francis Bacon's famous biliteral cipher[2] and Ignatius Donnelly's remarkable attempt[3] to prove, by means of a cipher, that Bacon was the author of Shakespeare's works.

Readers of Edgar Allan Poe's "Gold Bug" are probably aware of his belief that every cipher could be resolved and his challenge[4] to his readers to submit any which he could not decipher.

If any of our readers have never read Conan Doyle's "Adventures of the Dancing Man" a mention of it in this connection may lead to the enjoyment of its delightful mystery.

PROBLEMS AND SOLUTIONS.

EDITED BY B. F. FINKEL AND OTTO DUNKEL.

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PROBLEMS FOR SOLUTION.

2788. Proposed by WARREN WEAVER, University of Wisconsin.

Out of a freshman class of one thousand, various quiz sections are chosen by chance. After a semester's work A is found to stand 12th in a section of 18 students, and B is found to stand 18th

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of the French war office in obtaining, by an extraordinary accident, which can not now be made public, the key to the German radiograph cipher code. "General Joffre knew the German orders wherever the radiograph signal was used in the advance on Paris. And it is possible that the knowledge of the radiograph code enabled the American Government to decipher the messages sent from the great wireless station at Nauen to Count von Luxburg, and so to make public the vast system of German intrigue that has amazed the world" (p. 29).

Strother, French, "Fighting Germany's Spies," *World's Work*, June, 1918, pp. 134–153. Gives descriptions and examples of the "Playfair" cipher (used by the British army in the field and pronounced by Mr. Strother "the cleverest transposition cipher ever devised"), the "Chess Board" cipher and the Bolo Pasha code.

Literary Digest, "A Graphic Spy Code," Vol. 56, p. 38, and "Keeping Government Cipher-Codes Secret," Vol. 51, pp. 546–548.

[1] Cf., Smith, D. E., "John Wallis as a Cryptographer" *Bulletin of the American Mathematical Society*, Vol. 24, No. 2 (Nov. 1917) pp. 82–96.

[2] *The Works of Francis Bacon, Baron of Verulam, Viscount of St. Alban, and Lord High Chancellor of England*, collected and edited by James Spedding, Robt. Leslie Ellis and Douglas Denon Heath (London, 1879), Vol. I, pp. 659–661. In a note on p. 843 Spedding credits the idea of a biliteral cipher, which Bacon seems to claim as his own, to John Baptist Porta (cf. *l.c.* above) although employed by him in a different manner.

[3] Donnelly, Ignatius, "The Great Cryptogram," R. S. Peale & Co., Chicago, N. Y., London, 1888.

[4] *The Works of Edgar Allan Poe*, with an introduction and a memoir by Richard Henry Stoddard (A. C. Armstrong & Son, N. Y., 1884), Vol. I, pp. 431–451. This essay on "Cryptography" contains, according to the editor, all that Poe had to say of importance on the subject. The challenge, which was first printed in *Graham's Magazine* for July, 1841, is reprinted on p. 442.

In Stedman and Woodberry's edition of Poe's works (Chicago, 1896) the essay on "Cryptography" appears in volume 9, pp. 260–278.

in a section of 27 students. Show that, had the whole class of one thousand taken the work in one large section, the most probable result is that B would have finished the semester's work six places ahead of A, and that the expectation of B's lead on A is 11.

2789. Proposed by KURT LAVES, University of Chicago.

Given a quadrilateral $ABCD$ for which $AC + BC < AD + BD$ to construct, by means of the ruler and compass only, the pair of tangents from D to the hyperbola (ellipse) for which A and B are the foci and C a point on the hyperbola (ellipse).

2790. Proposed by J. W. LASLEY, JR., University of North Carolina.

How shall we buy 12 eggs for 80 cents, if eggs sell as follows: hen eggs at 5 cents each, duck eggs at 7 cents each, and turkey eggs at 8 cents each, provided we buy some of each?

2791. A cup of wine is suspended over a cup of equal capacity full of water; through a small hole in the bottom, the wine drips into the water, and the mixture drips out at the same rate. When the wine cup is empty, what part of the contents of the lower cup is water? [Proposed by Charles Gilpin, Jr., Philadelphia, as Problem 287 in *The Mathematical Visitor*, January, 1881, volume 1, page 193. No solution was published in the *Visitor*.]

2792. Proposed by B. J. BROWN, Kansas City.

Solve the differential equation,

$$x^2(1 - x)\frac{d^2y}{dx^2} + 2x(2 - x)\frac{dy}{dx} + 2(1 + x)y = x^2.$$

461 (Algebra) [June, 1916]. Proposed by E. T. BELL, University of Washington.

(1) Two events have probabilities p, q respectively. The events may be either (i) mutually independent; or (ii) mutually exclusive. Assign meanings to the symbol p^q, in terms of the two events where p^q is written for $p \times p \times \cdots \times p$, ($q$ factors p), in cases (i), (ii), and $p \times p$ has the customary meaning (as a probability).

(2) What relations, if any, other than (i) and (ii) can exist between two events? Upon what postulates is the answer to this based?

463A (Geometry) [May. 1915]. Proposed by B. J. BROWN, Kansas City.

If μ and ν are the parameters of the two confocal conics through any point on the ellipsoid

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1,$$

show that $\mu + \nu + a^2 + c^2 = 0$, along a central circular section.

470 (Geometry) [September, 1915]. Proposed by R. E. MORITZ, University of Washington.

Prove that

$$\theta = (\lambda + (q/p)\mu)\pi, \qquad (\lambda = 1, 2, 3, \cdots, q - 1;\ \mu = 0, 1, 2, \cdots, p - 1),$$

and

$$\theta = (2\lambda - 1)\pi/2 + (q/p)(4\mu \pm 1)\pi/2, \qquad (\lambda = 1, 2, 3, \cdots, (q - 1)/2;\ \mu = 0, 1, 2, \cdots, p - 1),$$

determine the same set of points on the curve $\rho = a \cos (q/p)\theta$, where p and q are two odd integers without a common factor, and a is any constant.

499 (Geometry) [November, 1916]. Proposed by NATHAN ALTSHILLER, University of Oklahoma.

Find the surfaces all the plane sections of which are circles.

501 (Geometry) [November, 1916]. Proposed by R. P. BAKER, University of Iowa.

Find the minimum amount of lumber one inch thick required to pack a gross of spheres three inches in diameter in a rectangular box.